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Atmospheric Infrared Sounder



Retrieved Surface Emissivity Impact of New Cloud-Clearing Channel Set

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Methodology

- First get cloud-clearing right, then fix surface retrievals
 - *Basic assumption of cloud-clearing - clouds have smallest scale of horizontal variability, **violated over land***
 - *Water poorly known – most problematic in boundary layer in tropics*
- Solution -> do not use channels:
 - *seeing surface during cloud clearing*
 - *sensitive to water vapor*
- Consequences
 - *Suceptible to missing low clouds*
 - *Fewer channels for cloud clearing*



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Channel Selection

- Use new channel set of temperature sounding channels

- *Old set: 45 channels*

- 666.26, 672.10, 681.46, 692.76, 693.03,
696.05, 700.78, 701.06, 702.74, 703.87,
704.44, 706.14, 706.99, 707.85, 708.71,
709.57, 711.00, 711.29, 712.74, 714.19,
714.48, 715.94, 721.84, 723.03, 723.33,
724.52, 726.33, 738.48, 746.01, 747.60,
749.20, 750.48, 753.06, 755.33, 790.32,
843.91, 937.91, 1092.45, 1133.94, 2419.83

- *New set: 16 channels*

- 655.39, 666.26, 666.51, 670.31, 670.57,
717.41, 717.99, 718.29, 718.58, 718.88,
719.17, 719.47, 719.76, 720.95, 721.54, 721.84

- New Channel set has too few channels



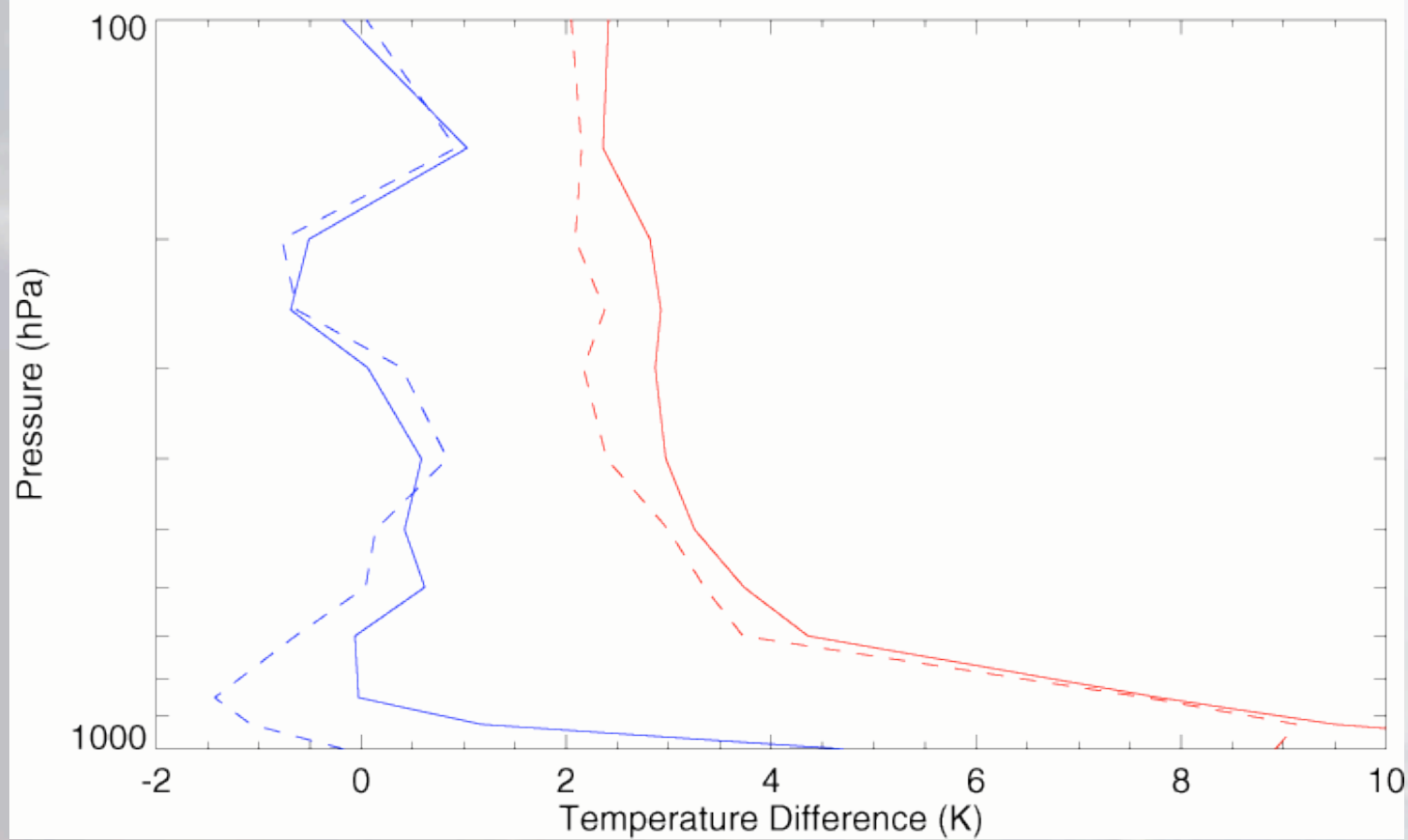
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Temperature Statistics (Net Meeting)

Temperature Differences over the North Africa
Night Time 2002-11-16, 850 hPa Air Temperature, Nominal
16 Nov 2002





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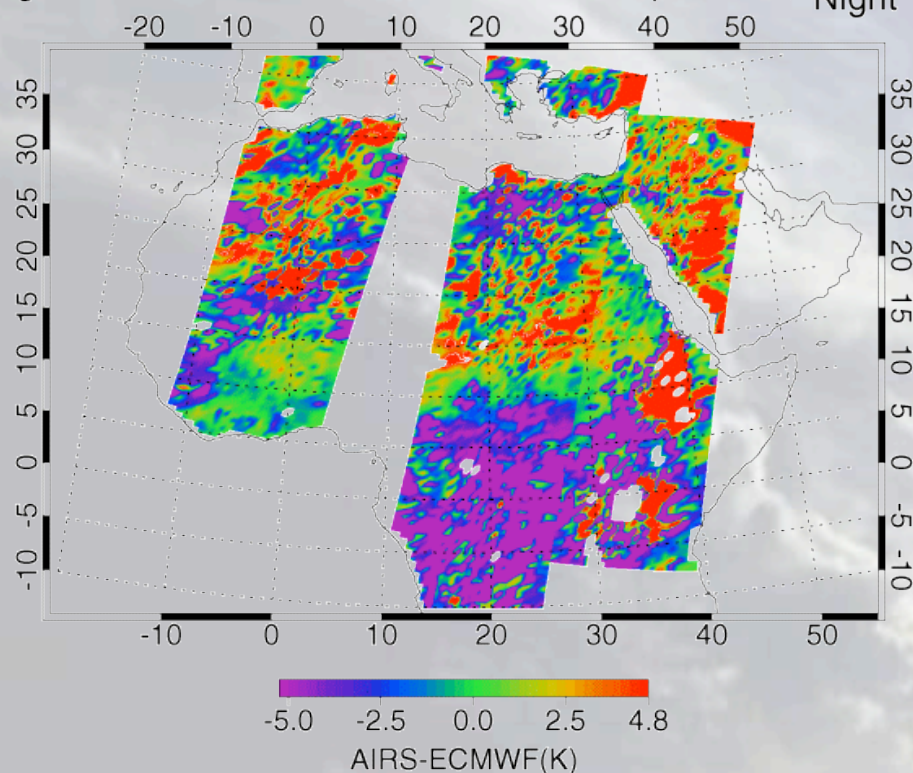
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850 hPa Temperature Variability

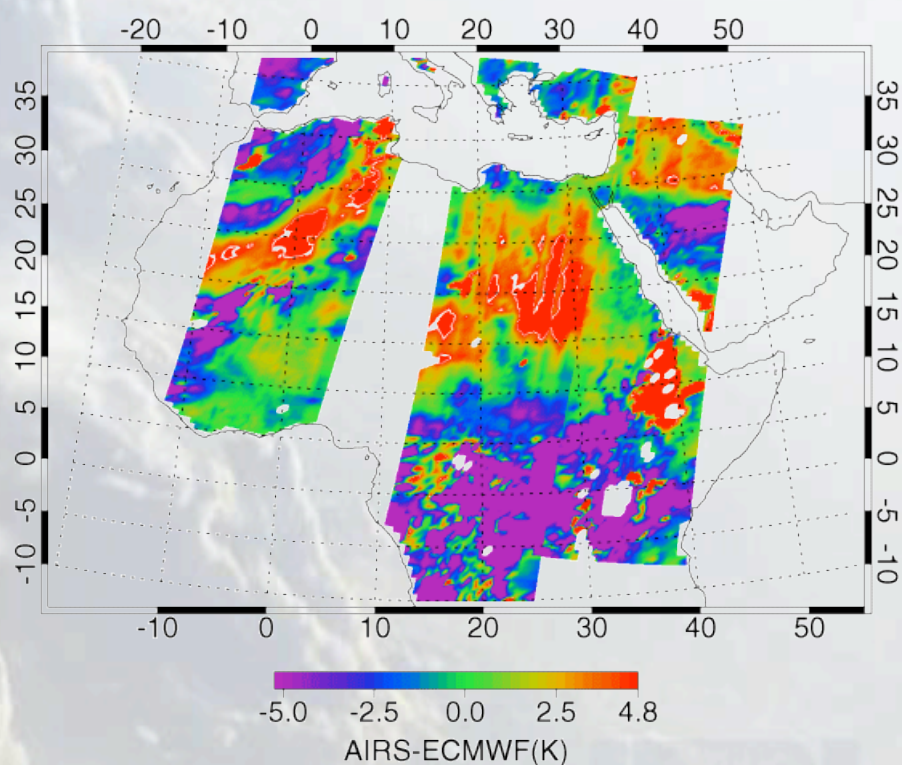
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- Retrieved minus ECMWF highly correlated**

Night Time 2002-11-16, 850 hPa Air Temperature, Nominal



Night Time 2002-11-16, 850 hPa Air Temperature, New CC Channel





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Status of Surface Retrieval

- **Compare AIRS and MODIS emissivity products**
- **Examine AIRS emissivity spectra at locations of known (?) composition**
- **Compare AIRS and laboratory emissivity spectra**



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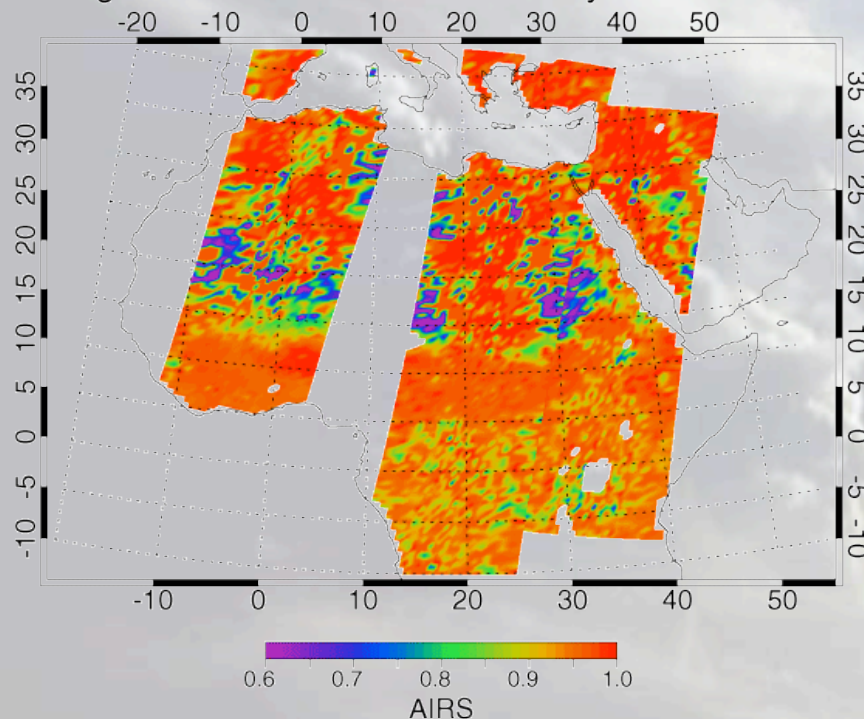
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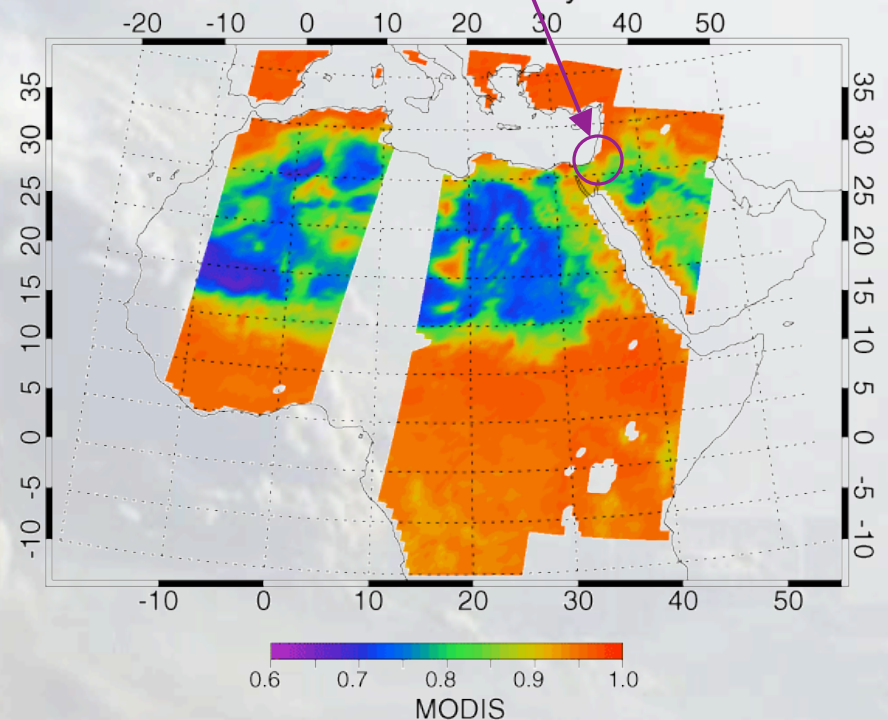
Emissivity at 9 μm Before

- No differences in emissivity between jungle and desert
- Strong depression in 9 μm emissivity in desert
- Weak feature over carbonate soils

Night Time 2002-11-16 Emissivity @ 1080 cm^{-1}



MODIS 2002-11-16 Emissivity @ 1169 cm^{-1}





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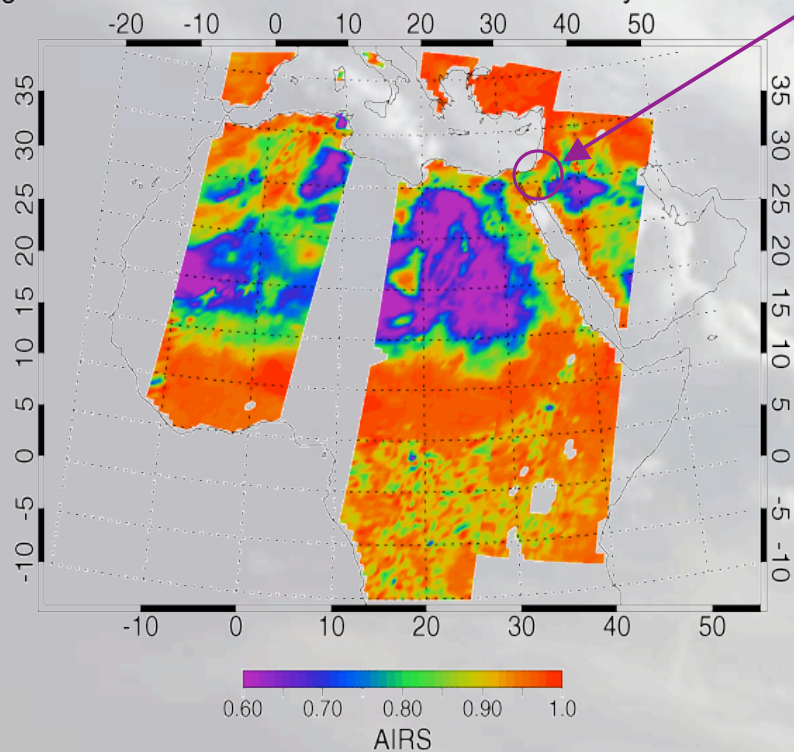
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Emissivity at 9 μm

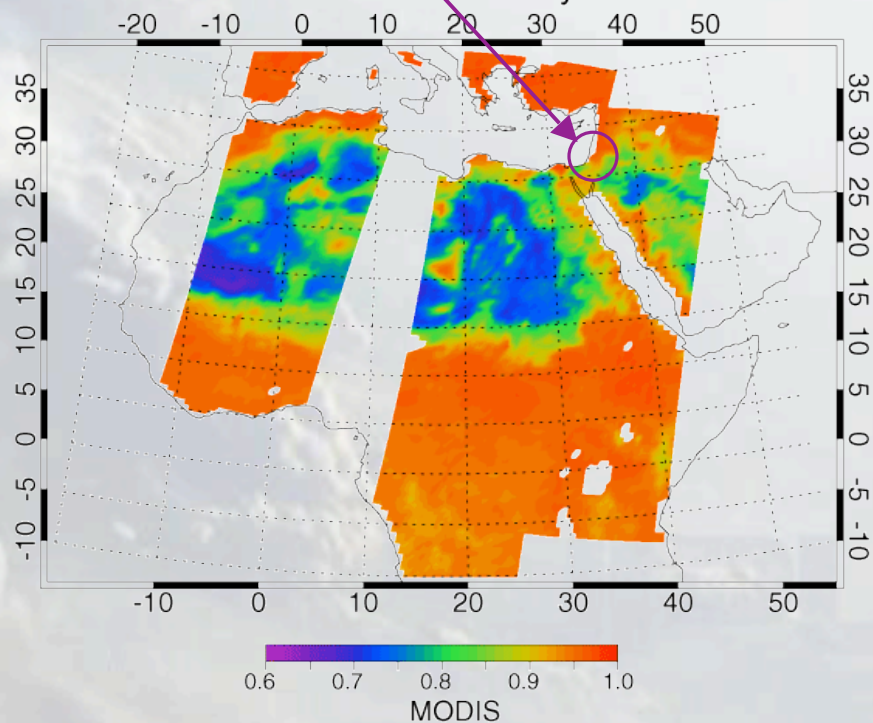
After

- Strong depression in 9 μm emissivity in desert
- Weak feature over carbonate soils

Night New Channel Set 2002-11-16 Emissivity @ 1080 cm^{-1}



MODIS 2002-11-16 Emissivity @ 1169 cm^{-1}





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Emissivity Spectra

- **Compare retrieved emissivity spectra with laboratory measurements**
- **Locations**

HaNegev, Israel	Carbonates
Egypt 1	Quartz sands
HaGolan Israel/Syria	Basalts
Monkoto, Zaire	Tropical forest



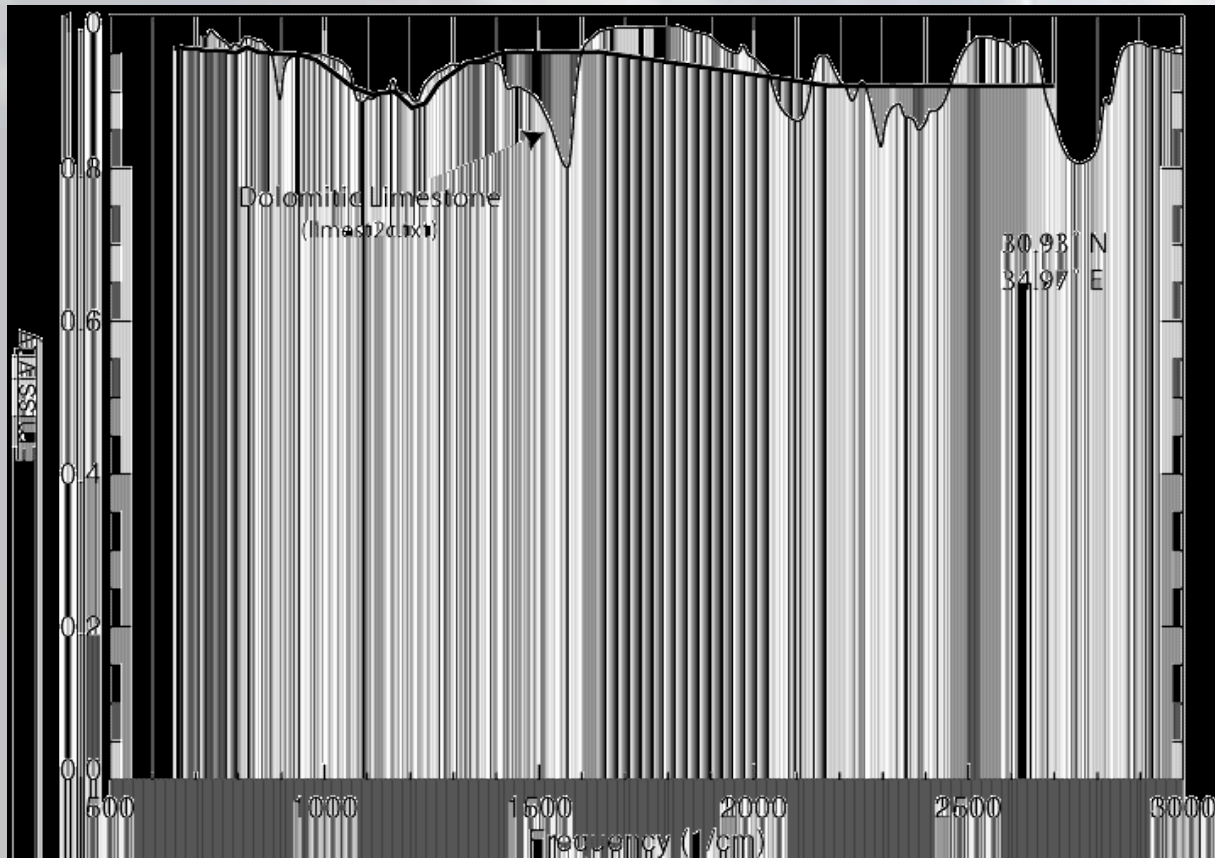
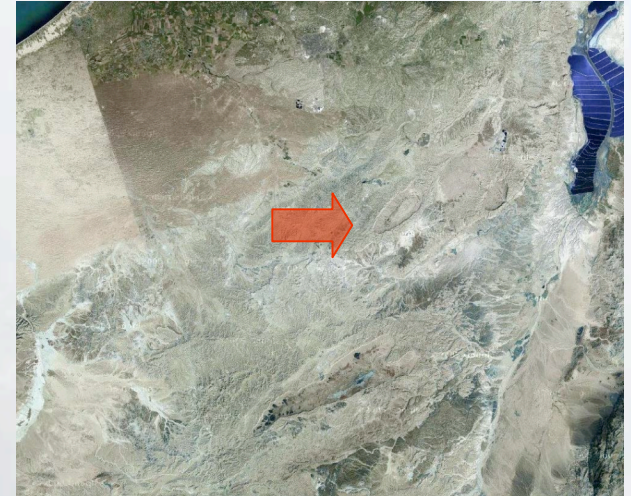
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Ha Negev (Israel)

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- Uplifted sea floor - carbonates





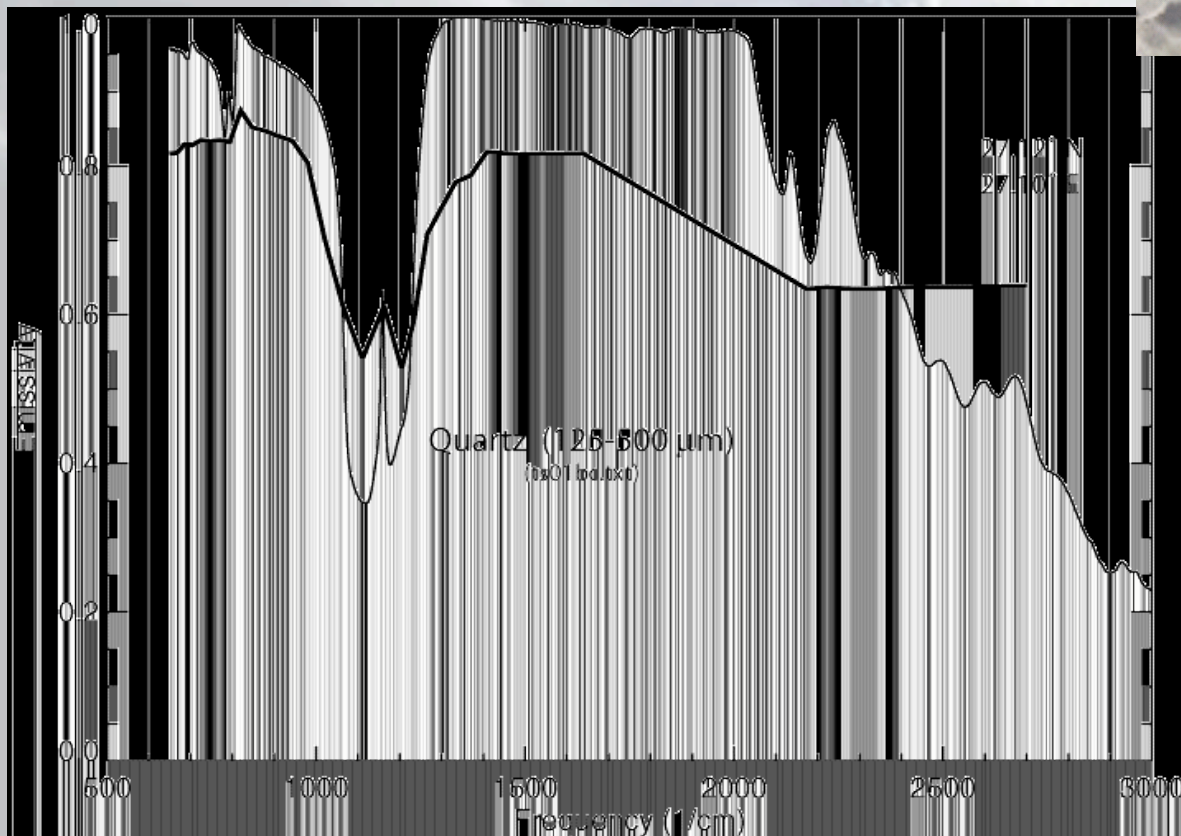
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Egypt One

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- Quartz Sands



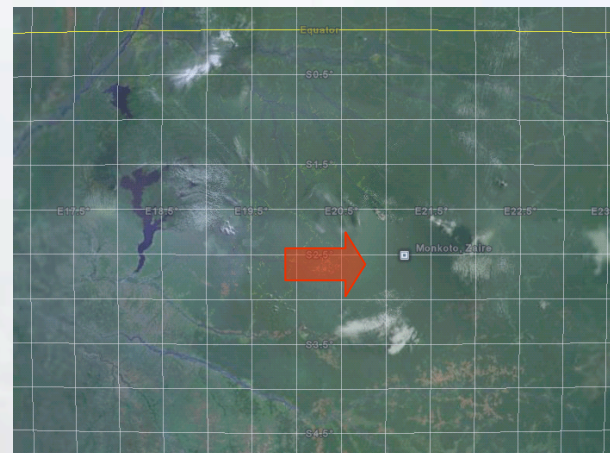
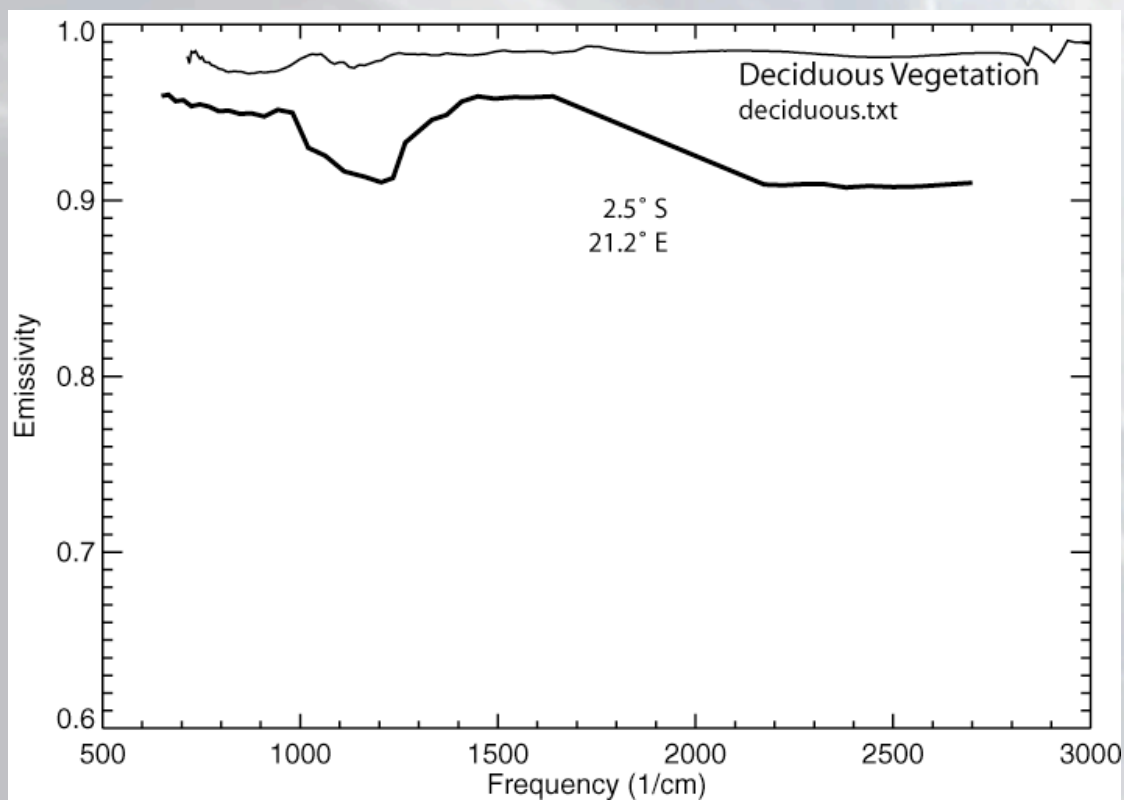


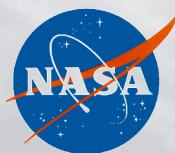
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Monkoto, Zaire

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- **Vegetated tropical rain forest**



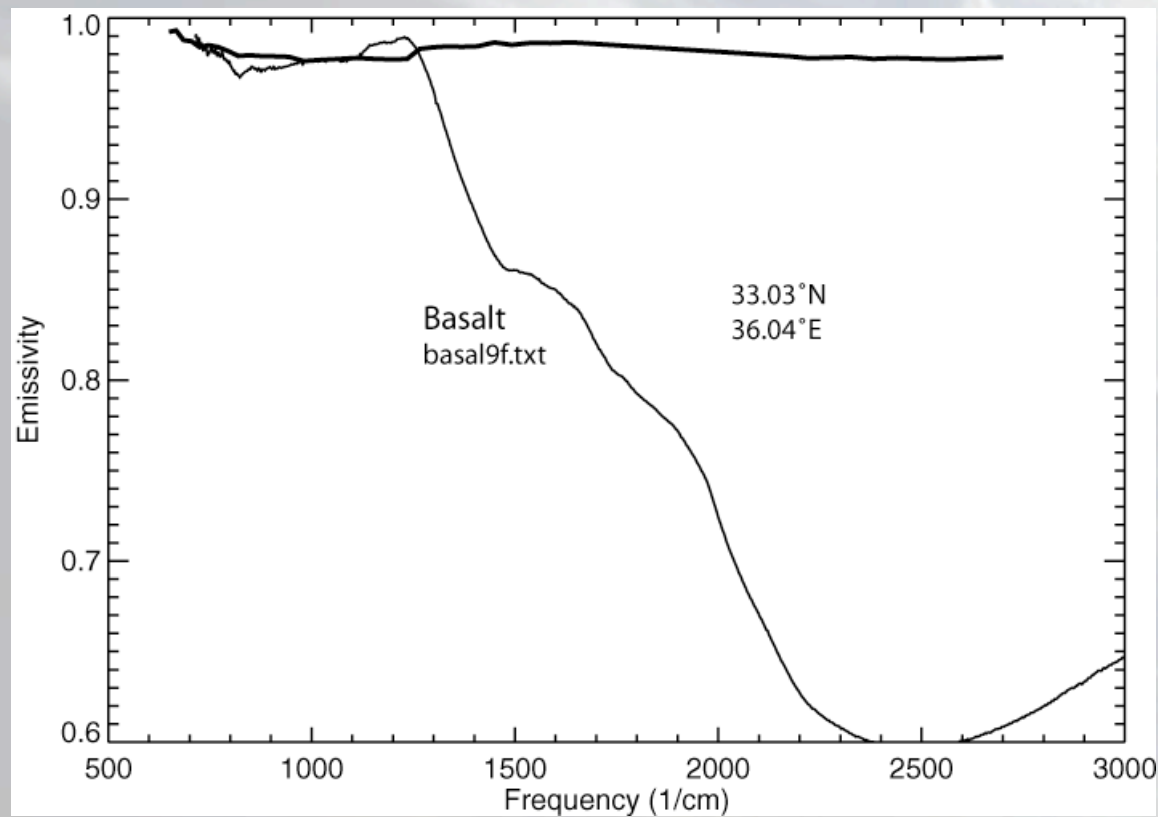
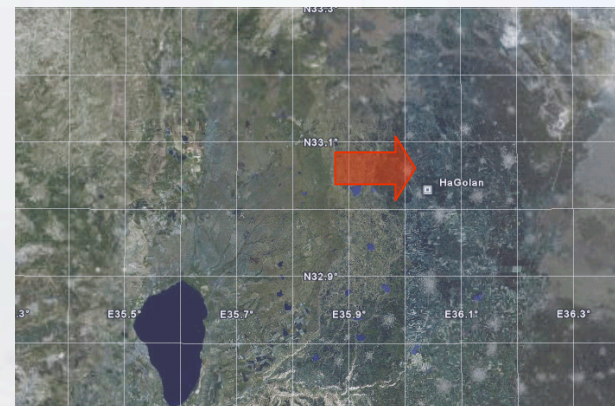


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HaGolan (Israel/Syria)

- **Rift flood basalts**





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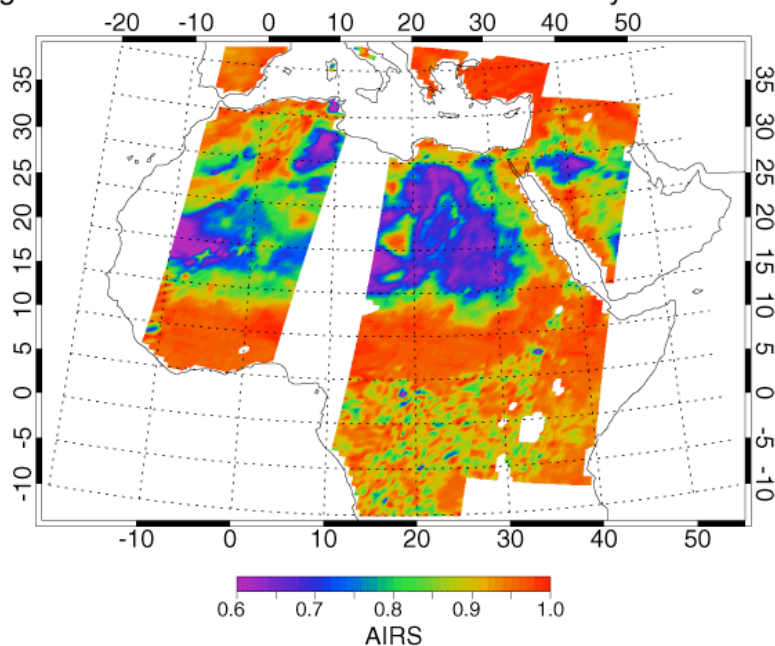
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Emissivity at $3.75 \mu\text{m}$

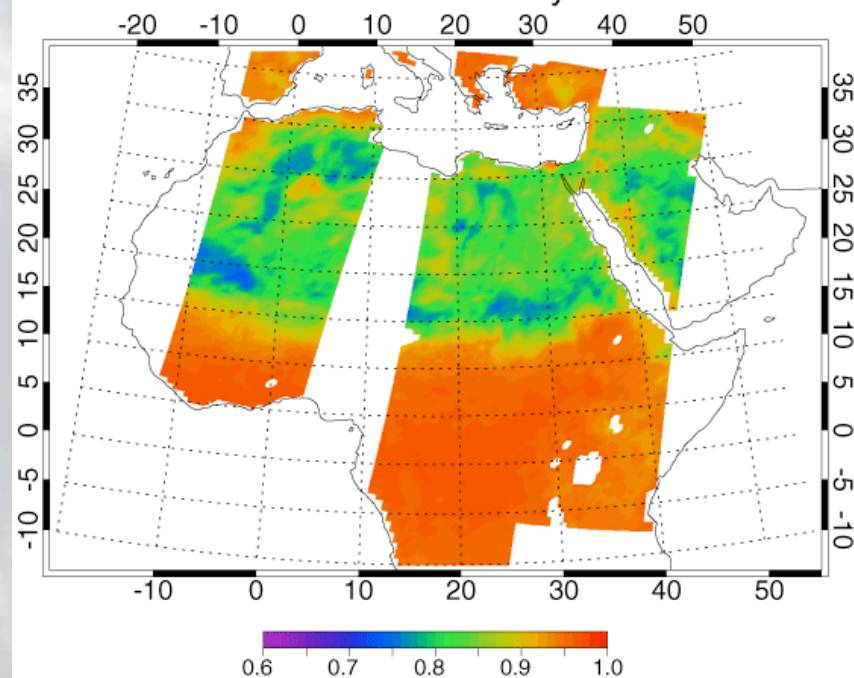
After

- Strong depression in $3.75 \mu\text{m}$ emissivity in desert
- No suppression over HaGolan (basalt).
 - *Vegetation or soil moisture obscures short wave absorption band?*

Night New Channel Set 2002-11-16 Emissivity @ 2700 cm^{-1}



MODIS 2002-11-16 Emissivity @ 2666 cm^{-1}





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Improving Surface Retrieval

- **Current surface emissivity retrieval is primarily regression**
 - **Is this sufficient?**
- **If not, can the physical surface retrieval be modified?**
 - *Use online-offline technique in narrow spectra band to determine surface temperature, then*
 - *derive consistent emissivity spectra across AIRS passband.*
 - **What is impact of surface temperature variability within footprint ?**
- **Emissivity hinge points vary between footprints use a common set at all stages.**
 - *Revist the regression hinge-point set.*



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Conclusion

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- Improving cloud-clearing improves emissivity.
- Regression has skill in distinguishing different rock types.
 - *Rocks have large emissivity variability*
- This proposed channel set improves land products.
- Caveat
 - *The test data is relatively cloud-free*
 - *Need to test it with larger set of data and increase channel set over land as necessary*
 - *How to validate surface emissivity?*



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Work needed for V5 Delivery

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- **Intercompare MODIS (MDY11C1) and AIRS surface temperature.**
 - *How variable is surface skin temperature within retrieval set?*
- **Add code to use different cloud-clearing channel sets for land and ocean (algorithm *tbd*)**
- **Prototyping “off-line” online-offline surface emissivity retrieval**
 - *Is regression emissivity sufficient?*
 - *Does surface temperature and emissivity match radiances?*
 - *Validate PGE surface products.*

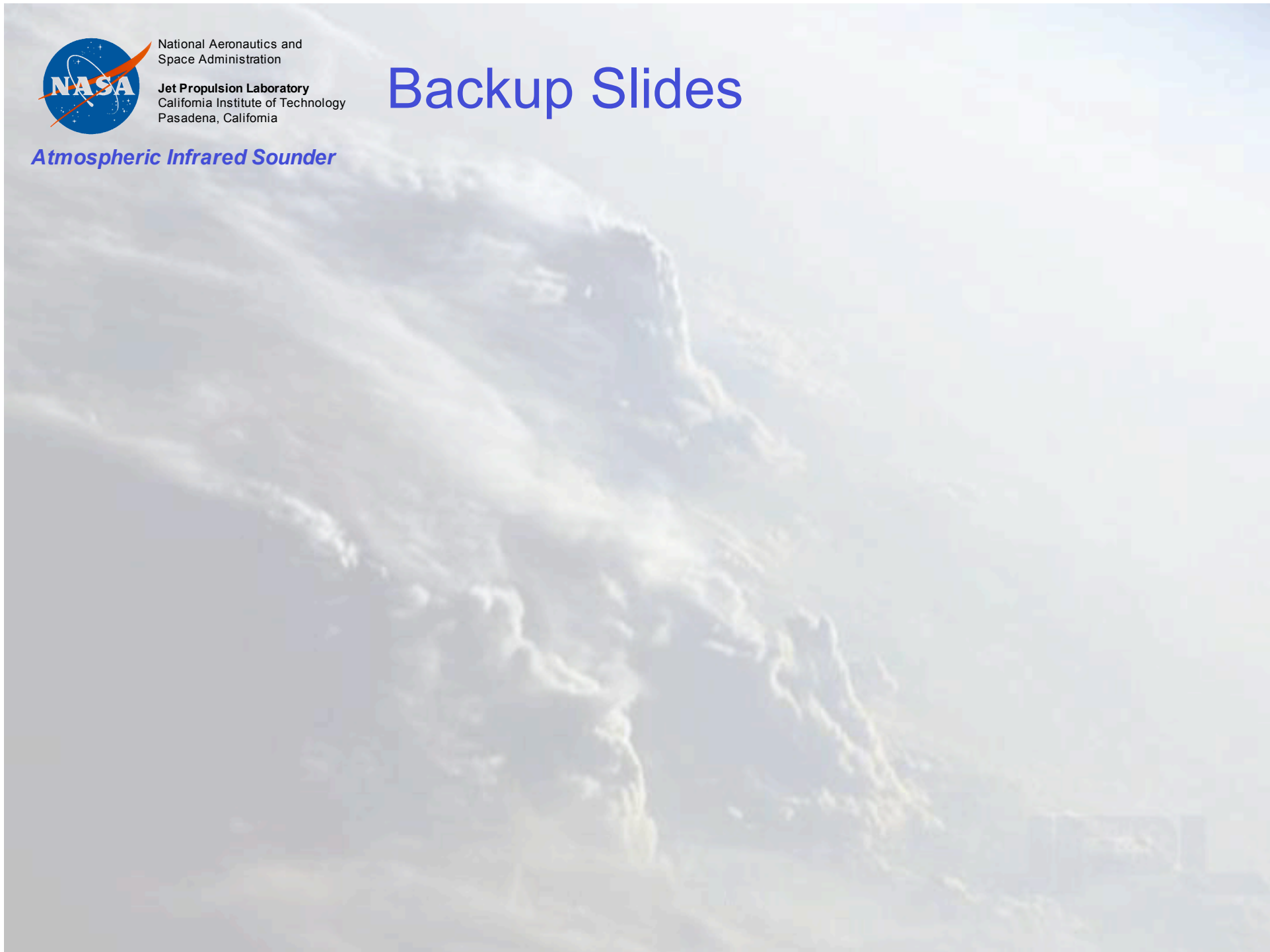


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Backup Slides

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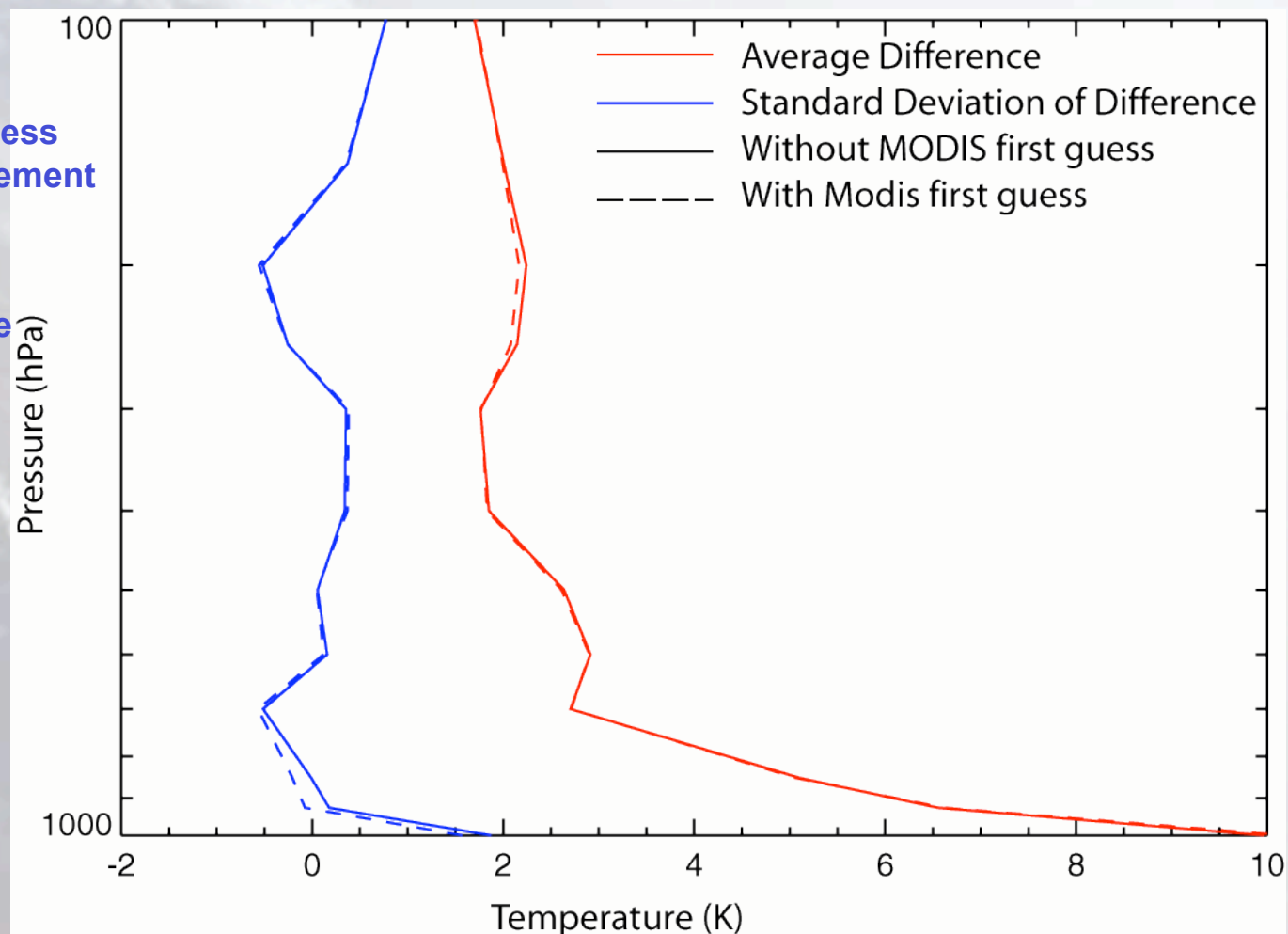
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Effects of MODIS emissivity

**MODIS emissivity first guess
provides minimal improvement**

- MODIS emissivity are
erroneous.
- Retrieval is unable to use
improved first-guess
emissivity.



North Africa, Granules: 1-3, 17-19, 232-233



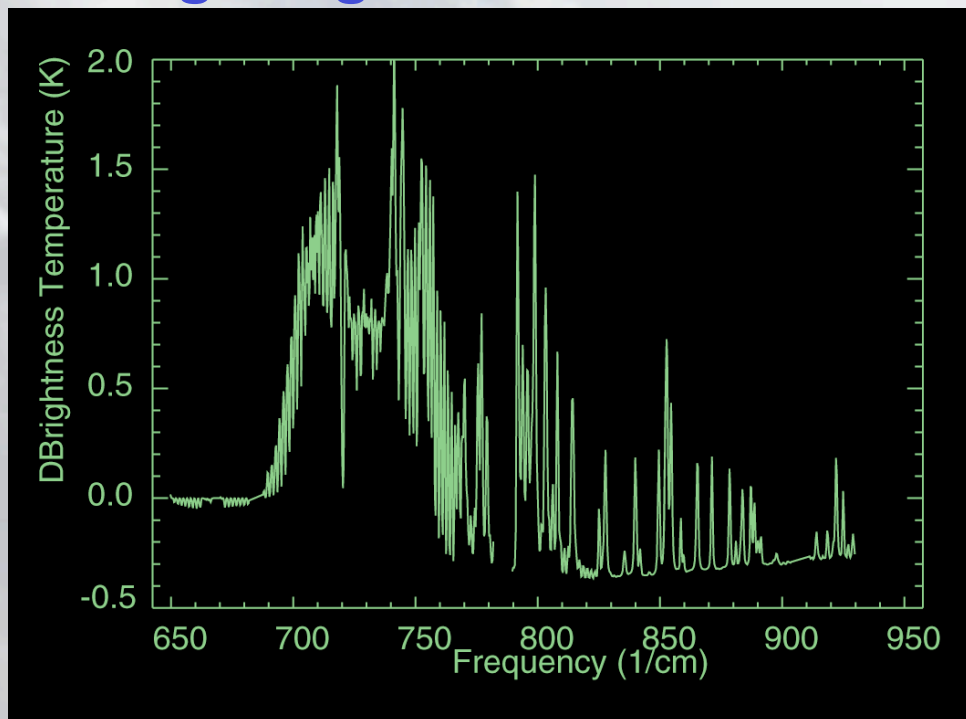
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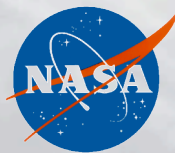
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Channel Selection

- Use channels as if performing simultaneous cloud clearing and temperature retrieval
- Use channels having variable temperature-dependence of weighting functions





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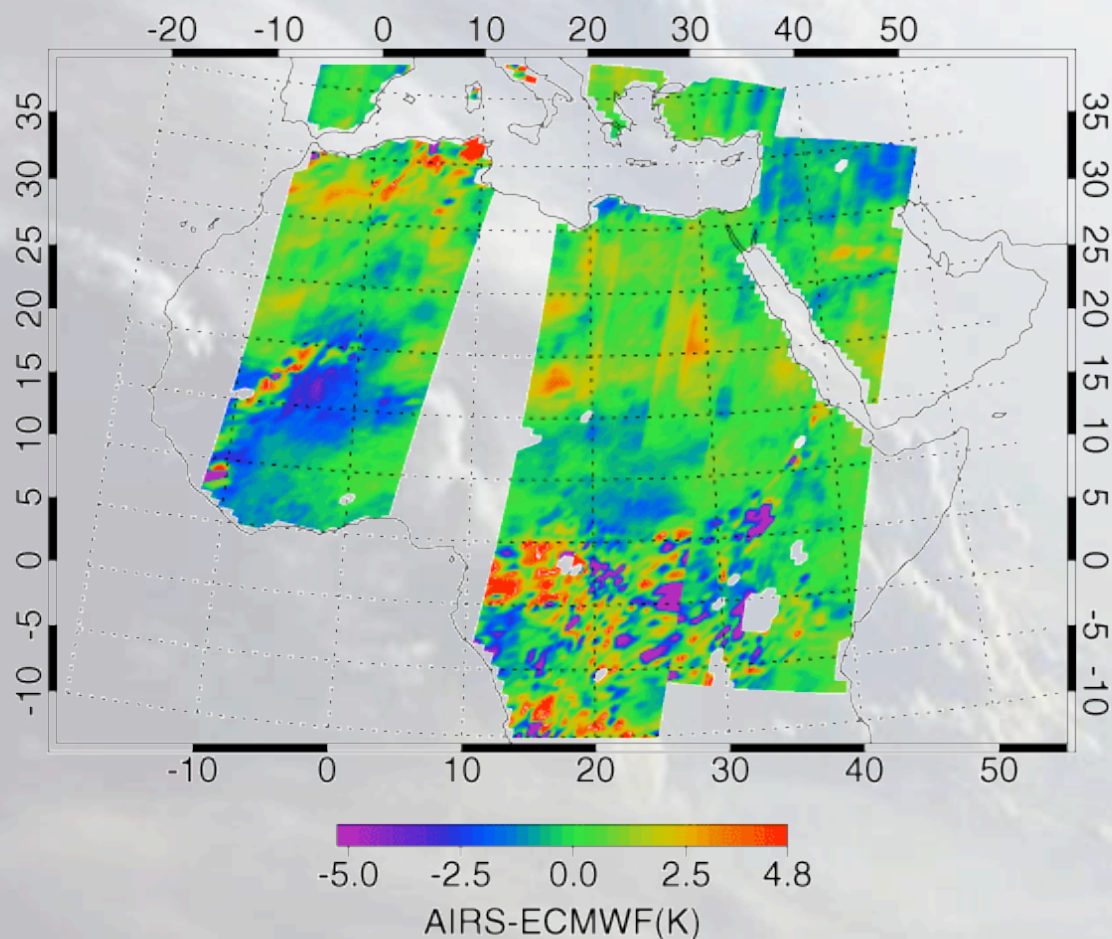
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500 hPa Temperature Variability

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- Retrieved minus ECMWF highly correlated

Night Time 2002-11-16, 500 hPa Air Temperature, New CC Channel Set





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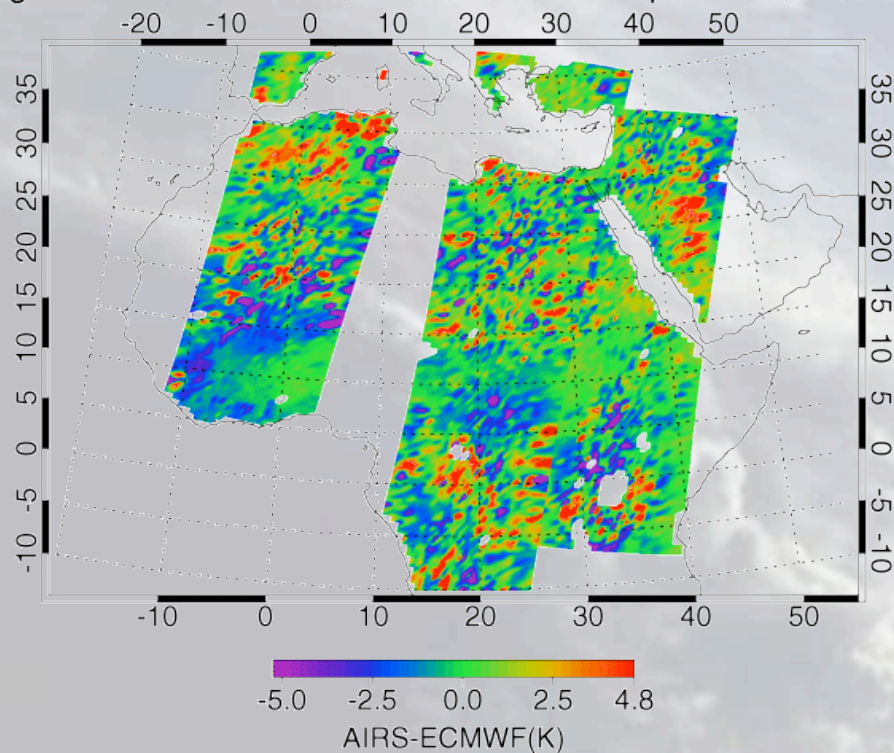
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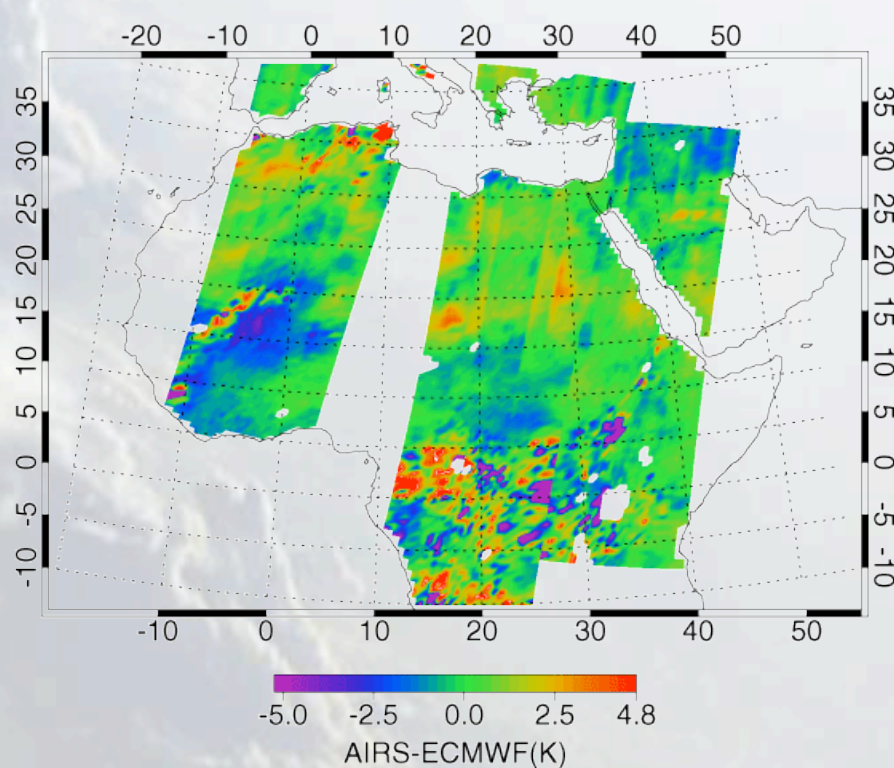
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- New versus Old**

Night Time 2002-11-16, 500 hPa Air Temperature, Nominal



Night Time 2002-11-16, 500 hPa Air Temperature, New CC Chan





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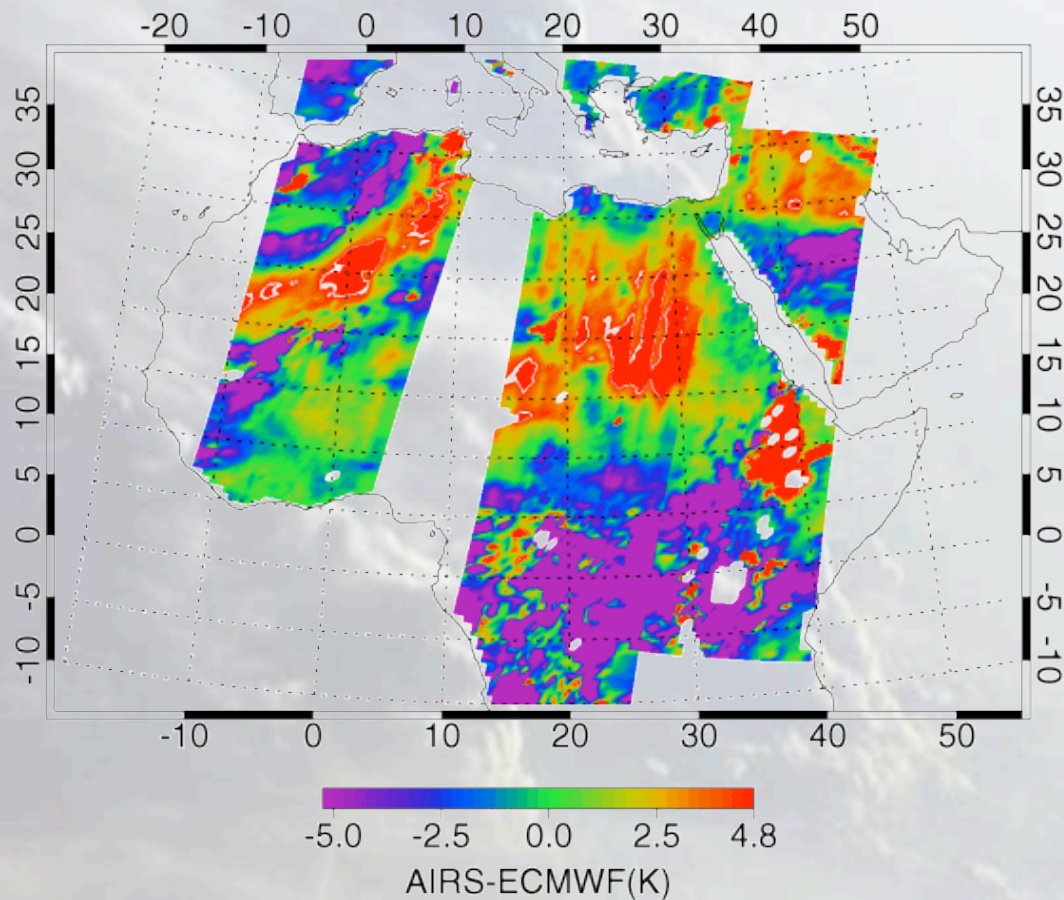
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850 hPa Temperature Variability

Atmospheric Infrared Sounder

- Retrieved minus ECMWF highly correlated

Night Time 2002-11-16, 850 hPa Air Temperature, New CC Channel Set





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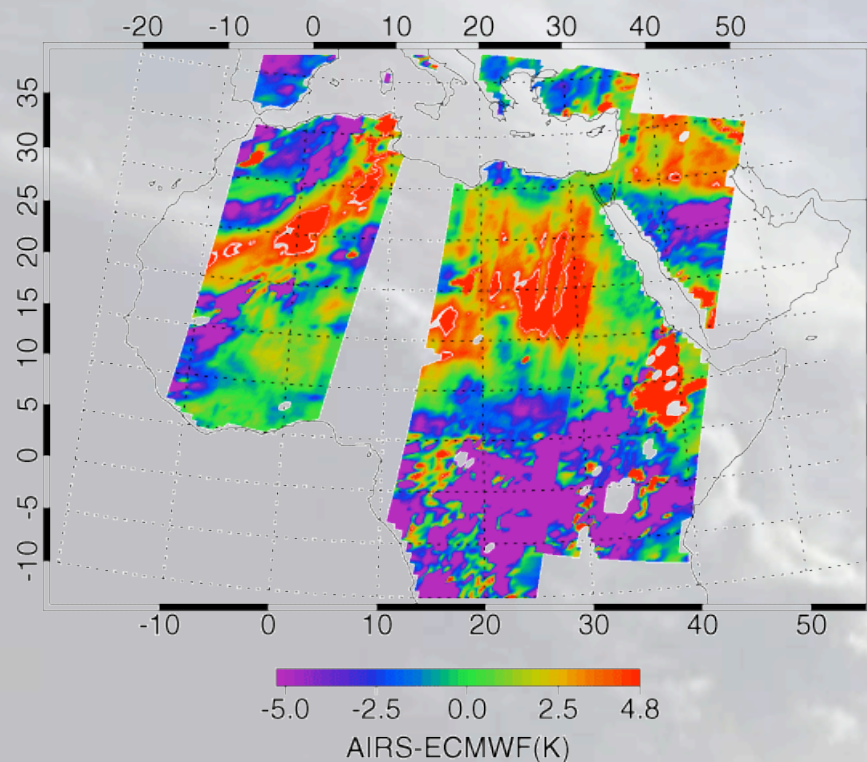
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850 hPa Temperature Differences

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- Difference correlated with meteorology

Day Time 2002-11-16, 850 hPa Air Temperature, New CC Channel Set



Night Time 2002-11-16, 850 hPa ECMWF Temperature

